

**Final Report**

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**Algorithm Development and Software Data System Design,  
Development and Verification for SeaWiFS Project**

(NAS5-31745)

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Evolution of CZCS processing environment and processing programs to support the SeaWiFS sensor. Assistance in processing system design and selection of equipment, use of processing control database; conversion of the L1 to L2 processing program to SeaWiFS reflecting the additional wavebands available to SeaWiFS and supported by the atmospheric correction algorithm developed by H. R. Gordon. A L2 to L3 binning program supporting SeaWiFS data products and a 9km bin size was developed. A mapping program to generate standard map projections from the L3 files was developed. All programs were integrated using the SeaWiFS defined processing conventions (program inputs) and SeaWiFS HDF input and output routines. Support was provided to incorporate program and algorithm changes and fixes in the programs.

Efforts expended during the period of April, 1992 through April, 1997 in support of the contract Algorithm Development and Software Data System Design, Development and Verification for SeaWiFS Project were directed to adapting the codes utilized developed for the Coastal Zone Color Scanner for use with processing ocean color data observed by the SeaWiFS instrument. The processing codes include a L2 generation program ANLY, two programs to combine orbit segments into daily or longer period global gridded files, SpaceBin9 and TimeBin9, and a mapping program to translate the gridded files into selected map projections, Map9.

The original ANLY program utilized a simplified atmospheric correction algorithm based on the 550 and 670 nm bands. While this approach produced reasonable results over much of the world's oceans, it encountered difficulties in areas of high in-water turbidity or unusual atmospheric aerosols. H. Gordon developed a more comprehensive atmospheric correction methodology based on a collection of aerosol models and a model selection technique oriented to choosing the most likely bounding scattering aerosols associated with each observed pixel. In water algorithms were selected by the SeaWiFS science team while data quality tests were developed by the SeaWiFS project and our team. The resulting algorithms were coded and integrated with the ANLY code base. SeaWiFS I/O routines supporting the product definitions and ancillary data (meteorological and ozone files) completed the ANLY package. The resulting code provides normalized water leaving radiances, K490, CZCS pigment and SeaWiFS chlorophyll with atmospheric correction and data quality computed on a pixel level basis. ANLY processes both the 1km HRPT and LAC as well as the 4km GAC SeaWiFS data modes.

Output from the ANLY program is then passed to the SpaceBin9 program where the L2 data is aggregated into standard, earth located, 9km, equal area, pixels selecting the highest quality pixels for binning and discarding those that failed the selected data quality masks. Twelve fields are binned including water leaving radiances for the 412, 443, 490, 510, 555 nm bands, aerosol radiance for 670 nm and 865 nm, the atmospheric correction parameter epsilon 765-865 nm, K490, CZCS pigment, SeaWiFS chlorophyll, and k490/chlorophyll. Results are accumulated as sums and sums of squares for each parameter, data quality flags, number of pixels and number of images contributing to the bin. The two sum fields are used to compute mean and standard deviation for each quantity. Resolution was improved by a factor of two, from 18km/pixel for CZCS, to 9km/pixel for SeaWifS.

After the L2 files are processed by SpaceBin9, they are collected into a daily global file by the program TimeBin9. This program analyzes the quality flags and selects the highest quality pixels for binning. Pixels of equivalent quality are added to the sum quantities and the pixel counter incremented. For the daily file, all granules and partial granules that fall within  $-180$  longitude and  $+180$  longitude for the appropriate time period (a near 24 hour interval defined by equatorial crossing time and longitude) are collected. Longer time intervals, *e.g.* 8 day 'week', month, and year are also supported by collecting the appropriate selection of daily, weekly,... files using TimeBin9. Quality flag selection for both of the binning programs is selectable via program input.

The sum and sum squared files are finally mapped into analyzable global fields by the program Map9. This program produces an output file containing the selected parameter - data type, mean or standard deviation, number of pixels, number of input images - at a selected resolution, latitude and longitude range and map projection. The mapped files are the final data files presented to the user of global data. Fields of selected quantities for both the 1 km LAC/HRPT or 4km GAC SeaWiFS observations can be mapped directly from the Level 2 ANLY output using SREMAP. This program also maps the various fields, ancillary and atmospheric correction model quantities, contained within the separate L2 QC ANLY output file.

The programs listed above were developed at RSMAS and delivered to the SeaWiFS project where project personnel integrated the programs into the SeaWiFS processing system. RSMAS personnel were involved in the definition phase of the SeaWiFS system and have continued to assist the project through maintenance of the processing programs. Periodic exchange of program source libraries between RSMAS and the SeaWiFS project has enabled both institutions to maintain consistency between their respective source libraries. Maintenance support has included analyzing coding problems, changes due to operating system upgrades, integrating algorithm improvements and comparison of results between the GSFC and Miami environments. Communication between the groups was maintained through frequent e-mail exchange, telecons as required and occasional trips. Software and changes were tracked using the UNIX CVS/RCS utilities documenting all coding changes. Quarterly reports were generated and submitted to NASA Headquarters and SeaWiFS project personnel.

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13. ABSTRACT (Maximum 200 words) This final report describes the evolution of CZCS processing environment and processing programs to support the SeaWiFS sensor; assistance in processing system design and selection of equipment; use of processing control database; conversion of the L1 to L2 processing program to SeaWiFS reflecting the additional wavebands available to SeaWiFS and supported by the atmospheric correction algorithm developed by H.R. Gordon. An L2 to L3 binning program supporting SeaWiFS data products and a 9km bin size was developed. A mapping program to generate standard map projections from the L3 files was developed. All programs were integrated using the SeaWiFS-defined processing conventions (program inputs) and SeaWiFS HDF input and output routines. Support was provided to incorporate program and algorithm changes and fixes in the programs.				
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